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GAS-BURNING CIGARETTE LIGHTERS AND FUEL REFILL CONTAINERS FOR USE WITH SUCH LIGHTERS

Hans Lowenthal, London, England

Granted to Colibri Lighters Limited, London, England

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No. OF CLAIMS 16

Some gas-burning cigarette lighters have a gas reservoir which can be refilled when empty from a bottle or other container containing liquefied gas. The reservoir which may either ~~by~~ be an integral part of the lighter or be detachable, has an inlet valve for this purpose which is opened by the application to it of the gas container.

It is most important when refilling the reservoirs of such lighters that the reservoir should not be completely filled with the liquefied gas and that a space should be left for expansion of the liquefied gas which takes place when the reservoir is warmed, for example by placing the lighter in a pocket or other warm place. If no space is left, expansion of the gas causes bulging or other deformation of the reservoir and this, besides damaging the lighter and valves, may be extremely dangerous because the reservoir might burst.

To prevent overfilling of the reservoir, supplies of liquefied gas have usually be sold in containers which hold only sufficient gas to fill the reservoir of any particular lighter, when empty, by the correct amount. Gas supplied in this way is, however, expensive because of the expense of the containers which is high compared with that of the gas.

The object of the present invention is to ensure that, when the reservoir of a gas burning lighter is refilled from a container holding sufficient liquefied gas to refill the reservoir more than once, at the end of the filling operation the reservoir is not entirely filled with liquefied gas.

According to the present invention, a coupling device for connecting a gas refill container to the

reservoir of a gas-burning cigarette lighter comprises a screw-threaded neck or socket adapted to be screwed into, or to receive, a complementary coupling device, closure means within the neck or socket, the closure means being normally closed but being arranged to be opened by the complementary device when the two devices are screwed together, and a venting passage in the wall of the neck or socket, the venting passage being so positioned that it is closed when the two devices are screwed fully together but is opened and allows gas to escape from the reservoir as the two devices are unscrewed from each other.

With this coupling device, the connection between the reservoir and the liquefied gas container is gas-tightly sealed whilst the filling operation is actually taking place but as the venting passage is opened during part of the time that the two parts of the coupling device are being unscrewed from each other, some of the gas which has been transferred from the container to be reservoir escapes to the atmosphere so that the reservoir is no longer entirely filled.

Although it is not essential, the venting passage is also opened as the two devices are screwed together as well as when they are unscrewed. This leads to a further very considerable advantage of the invention which is that, provided there is a small residual amount of gas in the reservoir when it is refilled, some of this gas will escape from the reservoir as the devices are screwed together. As it escapes, the gas expands and brings about a substantial cooling of, and lowering of the gaseous pressure within the reservoir. This cooling lowers the pressure in the reservoir considerably below that in the

refill container which is at atmospheric temperature. The excess pressure in the container forces the liquefied gas into the reservoir and greatly increases the speed of the filling operation which otherwise takes place only under gravity and by increasing the pressure in the container by warming it. For example, it has been found that a pocket cigarette lighter which previously took 20 to 30 seconds or even, under some circumstances, up to one minute to fill, can be filled, using a coupling device in accordance with the invention, in between 2 and 5 seconds due to the cooling of the reservoir and the lowering of the pressure in the reservoir by the escaping of the residual gas.

A coupling device in accordance with the invention may form a part of the liquefied gas container from which the reservoir of the lighter is filled, it may form a part of the reservoir of the lighter itself or it may be a part of a separate adaptor by means of which a gas refill container is connected to the lighter reservoir.

In the first of these cases, the container has a screw-threaded neck containing closure means which is arranged to be opened by means on the reservoir when the neck is screwed into a socket in the reservoir, and the neck has in its wall a venting passage which is so positioned that it is closed when the neck is screwed fully into the socket but is opened and allows gas to escape from the reservoir as the neck is unscrewed from the socket.

In the second case, the reservoir has a screw-threaded socket containing closure means which is normally closed but which is arranged to be opened by the neck of a refill container when the neck is screwed into the socket,

and the socket has in its wall a venting passage which is so positioned that it is closed when the neck is screwed fully into the socket but is opened and allows gas to escape from the reservoir through the closure means as the neck is unscrewed from the socket.

In the third case, the adaptor may comprise a part which is arranged to be fixed to the container and a screw-threaded neck containing closure means which is normally closed but which is arranged to be opened by means on the reservoir when the neck is screwed into a socket on the reservoir. The neck then has the venting passage formed in its wall in the same way as the venting passage is formed in the neck of a gas container, the passage being so positioned that it is closed when the neck is screwed fully into the socket, but is opened and allows gas to escape from the reservoir through the closure means as the neck is unscrewed from the socket. Alternatively, the adaptor may comprise a neck which is arranged to be screwed into a screw-threaded socket on the reservoir and a screw-threaded socket containing closure means, which is normally closed but which is arranged to be opened by the neck of a refill container when the neck is screwed into the socket, and the socket has in its wall the venting passage so positioned that it is closed when the neck of the container is screwed fully into the socket but is opened and allows gas to escape from the reservoir through the closure means as the neck of the container is unscrewed from the socket in the adaptor.

The venting passage may be in the form of an enclosed bore formed through the wall of the neck of the container or the socket of a reservoir, but preferably it is a groove

formed either in the outer surface of the neck or in the inner surface of the wall of the socket. In the former case, the groove extends along the neck from the end of the neck to a position between the ends of the screw thread on the neck and in the latter case the groove extends along the socket from the open end towards the inner end of the socket. The arrangement with an adaptor is similar.

The closure means contained within the neck of a gas container may be a self-sealing rubber diaphragm which is pierced by a hollow piercing element on the lighter reservoir when the neck is screwed into the socket in the reservoir, but preferably the closure means is a spring-loaded valve. The closure means in the socket of the lighter reservoir is preferably in all cases a spring-loaded valve.

When the neck of the gas container contains a spring-loaded valve, the spring which holds this valve shut is preferably stronger than the spring of the valve on the lighter reservoir. Thus, as the neck of the gas container is unscrewed from the socket on the reservoir, the valve in the neck of the gas container closes shortly before the valve in the reservoir. It is during this time that the venting passage is opened so that gas is allowed to escape from the reservoir but not from the gas container.

Some examples of coupling devices in accordance with the invention are illustrated in the accompanying drawings, in which:-

Figure 1 is a side elevation, partly in section, of the reservoir of a gas-burning cigarette lighter and a fuel container before the neck of the container is screwed into

the socket in the ligher reservoir;

Figure 2 is a cross-section as seen in the direction of the arrows on the line II:II in Figure 1;

Figure 3 is a section similar to that shown in Figure 1 of parts of the container and reservoir shown in Figure 1 but with the neck of the container screwed fully into the socket on the reservoir;

Figure 4 is a section similar to that shown in Figure 3 but with the neck of the container partly unscrewed from the socket in the reservoir;

Figure 5 is a section through parts of another refill container and of a lighter reservoir before the neck of the container is screwed into the socket on the reservoir;

Figure 6 is a section similar to Figure 5 but showing the neck of the container screwed fully into the socket in the reservoir;

Figure 7 is another section similar to Figure 5 but showing the neck of the container partly unscrewed from the socket on the reservoir;

Figure 8 is a section similar to Figure 3 showing a modification of the gas refill container;

Figure 9 is a section similar to Figure 6 but showing a modification of the lighter reservoir;

Figure 10 is a section through part of a gas refill container and through an adaptor screwed on to the neck of the container;

Figure 11 is a section similar to Figure 10 but showing another adaptor; and

Figure 12 is a section through part of another reservoir.

As seen in Figure 1, the reservoir 1 of a gas-burning cigarette lighter has a burner outlet 2 with an outlet valve 3. In the same wall of the reservoir as the burner 2 is a screw-threaded socket 4 which is arranged to receive the neck of a gas container for refilling the reservoir 1 when all the gas in it has been burnt.

In the bottom of the socket 4 is an inlet valve 5 which is normally held in the closed position on a seat 6 by a compression spring 7. The valve 5 has a stem 8 and this is surrounded within the socket 4 by a sealing washer 9. A gas refill container 10 has an externally screw-threaded neck 11 within which is a valve 12 having a stem 13. The valve 12 is normally held in the closed position on a seating 14 by a spring 15 which is held in position by a ring 16. In the outer surface of the neck 11 is a venting passage in the form of a groove 17.

To refill the reservoir 1, the neck 11 is screwed into the socket 4. As this is done, the end of the stem 8 comes into contact with the end of the stem 13 and both the valves 5 and 12 are opened against the action of their respective springs 7 and 15. The spring 15 is stronger than the spring 7 and in consequence the valve 5 is opened further than the valve 12. When the neck 11 is screwed fully into the socket 4 as shown in Figure 3, the end of the neck 11 comes into contact with the sealing washer 9. Gas is thus able to flow through a bore 18 in the neck 11 and thence through the valve 5 and through openings 19 into the inside of the reservoir 1. While this is happening, the venting groove 17 is shut off by screw threads 20 at the mouth of the socket 4 and is also shut off by the contact between the end of the neck 11 and the

washer 9. It is seen, therefore, that it is directly closed by the socket 4.

As shown in Figure 4, however, as the neck 11 is unscrewed from the socket 4, the upper end of the venting groove 17 is opened as it protrudes beyond the mouth of the socket 4 and the lower end of the venting groove 17 is opened as the end of the neck 11 moves out of contact with the washer 9. When this stage of the unscrewing of the neck 11 has been reached, the valve 12 is closed by its spring 15 but the valve 5 remains partly opened against the action if its spring 7. Some gas, therefore, escapes from the reservoir 1 through the openings 19 past the valve 5 and through the venting groove 17. This escape continues until the neck 11 is completely unscrewed from the socket 4 and the valve 5 is consequently closed by its spring 7. Because of this escape of gas, the reservoir which may have been completely filled with liquefied gas from the container 10, remains no longer completely filled and there is a small space which contains gas in its gaseous phase.

The parts of the reservoir 1 and of the gas container 10 shown in Figures 5 to 7 are the same as those shown in Figures 1 to 4 and have the same reference numerals, with the exception that the neck 11 of the container 10 is not provided with any venting groove 17 but instead a groove 21 which forms a venting passage is provided in the inner surface of the socket 4. The groove 21 performs precisely the same function as the groove 17. When the neck 11 is screwed fully into the socket 4, the groove 21 is closed by the inner end of the neck 11 as shown in Figure 6 but when the neck 11 has been partly

unscrewed from the socket 4 as shown in Figure 7, the groove 21 is opened whilst the valve 5 is still partly opened and gas is allowed to escape to the atmosphere from the reservoir 1.

The example shown in Figure 8 is similar in all its details to that shown in Figures 1 to 4, with the exception that the neck 11 of the gas container 10 is provided with an oblique bore 22 which forms a venting passage in place of the groove 17.

The example shown in Figure 9 is similar to that shown in Figures 5 to 7, with the exception that an oblique bore 23 is formed through the wall of the socket 4 in place of the groove 21.

The effect of the bores 22 and 23 shown in Figures 8 and 9 are, however, identical with the effect of the grooves 17 and 21.

To achieve the effects of the invention with existing gas containers and gas reservoirs, an adaptor may be provided which screws on to the neck 11 of the container and has a neck which is screwed into the socket 4 in the reservoir 1. Two examples of such adaptors are shown in Figures 10 and 11.

In the example shown in Figure 10, a neck 24 of the adaptor contains a valve 25 having a stem 26, the valve being held shut by a spring 27 which abuts against a washer 28. The washer 28 has a projecting pin 29 which comes into engagement with the stem 13 of the valve 12 and opens this valve against the action of the spring 15 when the neck 11 is screwed into position in a socket 30 in the adaptor. The joint between the neck 11 and the socket 30 is sealed by a washer 31. A venting passage in the

form of a groove 32 is provided on the outside surface of the neck 24. This groove functions in exactly the same manner as the groove 17 provided in the neck of the container 10 shown in Figures 1 to 4 of the drawings. This adaptor is screwed permanently in position on the neck 11 of the container 10. When it is required to fill the reservoir of a lighter, the neck 24 is screwed into the socket 4 of the reservoir. When refilling is complete, the neck 24 is unscrewed and some gas escapes from the reservoir through the groove 30.

The adaptor shown in Figure 11 comprises a neck 33 having openings 34 passing through it. The neck 33 contains a valve 35 which is normally held shut on a seating 36 by a spring 37. The valve 35 has a stem 38 which extends into a socket 39 which receives the neck 11 of the container 10. A venting passage in the form of a groove 40 is formed in the socket 39. In use, the neck 33 of the adaptor is first screwed into the socket 4 of the reservoir and the end of the neck comes into contact with and opens the valve 5. Gas is, however, prevented from escaping from the reservoir by the valve 35 which is closed by the spring 37. The neck 11 is then screwed fully into the socket 39 as shown in Figure 11. When the reservoir 1 has been filled, the neck 11 is unscrewed from the socket 39. As this happens, the lower end of the groove 40 is opened whilst the valve 35 is still held open and gas escapes from the reservoir 1 through the groove 40. When the neck 11 has been completely unscrewed, the valve 35 closes. The neck 33 of the adaptor is then unscrewed from the socket 4 in the reservoir 1.

In all the examples so far described, the venting

passage is closed directly by the complementary coupling device when the two coupling devices are screwed fully together. In the modification shown in Figure 12, however, a venting passage 41 is provided in the wall of the socket 4. When the neck of a gas refill container is screwed fully into the socket 4, a washer 42 is pressed downwards and closes the inner end 43 of the passage 41. As the neck is unscrewed, however, the washer 42 is lifted by the gas pressure within the reservoir and gas is allowed to escape to the atmosphere through the passage 41. In this case, it will be seen that the venting passage 41 is closed indirectly by the neck of the gas container, the washer 42 in effect forming a secondary valve which is operated by the neck of the refill container.

Supplementary Disclosure.

A further example of a cigarette lighter reservoir and a gas refill container having a coupling device in accordance with the invention are illustrated in the accompanying drawings, in which:-

Figure 13 is a side elevation with parts shown in section of the reservoir and the refill container separated from each other;

Figure 14 is a section to a larger scale of the socket of the reservoir and the neck of the container screwed fully together;

Figure 15 is a section similar to Figure 14, but showing the neck partly unscrewed from the socket; and,

Figure 16 is another section similar to Figure 14, but showing the neck unscrewed still further from the socket.

As shown in Figure 13, the lighter reservoir comprises a tank 1' having an outlet valve forming a burner 2' and a socket 3' for connection of a gas refill container. The socket 3' has a non-return valve 4' which is pressed by a spring 5' against a seat 6'. The non-return valve 4' has an upwardly projecting pin 7' which extends into the socket 3'. A refill container 8' has a neck 9' having a screw thread 10' on its end. The neck 9' contains a non-return valve 11' which is pressed on to a seating 12' by a spring 13', the lower end of which abuts against the valve 11', and the upper end of which abuts against a ring 14' fixed in the neck 9'.

When, as shown in Figure 14, the neck 9' is screwed fully into the socket 3', the end surface 15' of the neck 9' comes into contact with and compresses a rubber sealing washer 16' in the socket 3'. Also a pin 17' extending from

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the non-return valve 11' comes into contact with the pin 7' so that both the non-return valves 4' and 11' are opened against the action of their respective springs 5' and 13'. The spring 13' is stronger than the spring 5' and in consequence the valve 4' is moved against the action of its spring 5' some distance before the valve 11' is moved off its seat 12'. Consequently when, as shown in Figure 14, the neck 9' is screwed fully into the socket 3', the valve 4' is opened further than the valve 11'.

The neck 9' is sealed in the socket 3' by the engagement of its end surface 15' with the washer 16' and liquefied gas flows through an internal bore 18' in the neck and thence through an opening 19' in the seating 6' and openings 20' in a base 21' of the socket 3' into the inside of the tank 1'. No leakage of the gas can occur. When the tank 1' has been completely filled with liquefied gas the neck 9' is unscrewed from the socket 3'. When the neck has been unscrewed as far as is shown in Figure 15, the valve 11' is closed by its spring 13', but the valve 4' is still held open against the action of its spring 5' by engagement between the pins 17' and 7'. The neck 9' remains sealed within the socket 3' by engagement of the surface 15' with the washer 16', the washer 16' having expanded as the neck 9' is unscrewed. Further unscrewing of the neck 9' into the position shown in Figure 16, however, moves the surface 15' out of contact with the sealing washer 16', but the valve 4' is still held off its seat 6'. Gas from the tank 1' can therefore flow back into the space between the end of the neck 9' and the inside of the socket 3'.

The screw thread 10' on the end of the neck is of V-shaped section, but the screw thread 22' with which it engages in the socket 3', although it has roots of similar

section, has a flat crest 23'. There is therefore a triangular clearance 24' between the crests 23' and the roots of the thread 10'. The clearance 24' forms a helical venting passage which leads from the inside of the socket 3' to the outside air. Gas can therefore escape to the atmosphere from the inside of the tank 1'. This escape continues whilst the neck 9' is unscrewed from the socket 3' from the time when the surface 15' comes out of engagement with the washer 16' until the neck 9' is sufficiently far unscrewed to allow the valve 4' to be closed by its spring 5'. Sufficient escape of gas occurs in this time to ensure that the tank 1' has a space filled only by gas in the gaseous phase and this allows expansion of the liquefied gas to take place when a rise of temperature within the tank 1' occurs.

As an alternative to flattening the crest of the screw threads 22' in the socket 3', their threads may be V-shaped and the crest of the thread 10' on the neck 9' may be flattened. This provides a triangular clearance similar to the clearance 24'.

The closure of the venting passage may alternatively be effected by providing some turns on the screw threads in the socket and on the neck which are close fit with one another. These close fitting turns are arranged to come into engagement with each other as the neck is screwed far enough into the socket to start the opening of the valve in the neck and to remain in engagement with each other while the neck is screwed fully into the socket. When the neck is unscrewed from the socket, the close fitting turns come out of engagement with each other as soon as the valve in the neck is closed and the venting passage between the reservoir and the atmosphere is thus open until the valve in the socket is closed.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A coupling device for connecting a gas refill container to the reservoir of a gas-burning cigarette lighter, the device comprising a screw-threaded neck or socket adapted to be screwed into, or to receive a complementary coupling device, a closure member within the neck or socket, the closure member being urged by a resilient part to a closed position but being engaged by the complementary device and opened against the action of the resilient part when the two devices are screwed together, and a venting passage in the wall of the neck or socket the venting passage being associated with closure means which close the venting passage when the two devices are screwed fully together but which open the venting passage to allow gas to escape from the reservoir as the two devices are unscrewed from each other.

2. A gas container for refilling the reservoir of a gas-burning cigarette lighter, the container having a screw-threaded neck containing closure means which is urged by a resilient part to a closed position but which is arranged to be opened against the action of the resilient part by means on the reservoir when the neck is screwed into a socket in the reservoir, the neck having in its wall a venting passage which is associated with closure means which close the venting passage when the neck is screwed fully into the socket but which opens the venting passage to allow gas to escape from the reservoir as the neck is unscrewed from the socket.

3. A gas reservoir for a gas burning cigarette lighter, the reservoir having a screw-threaded socket containing closure means which is urged by a resilient part to a closed position but which is arranged to be opened against the action of the resilient part by the neck of a refilled container when the neck is screwed into the socket, the socket having in its wall a venting passage which is associated with closure means which close the venting passage when the neck is screwed fully

into the socket but which open the venting passage to allow gas to escape from the reservoir as the neck is unscrewed from the socket.

4. A container according to claim 2, in which the venting passage is a groove in the outer surface of the neck, the groove extending along the neck from the end of the neck to a position between the ends of the screw thread on the neck.

5. A reservoir according to claim 3, in which the venting passage is a groove in the inner surface of the wall of the socket, the groove extending along the socket from the open end towards the inner end of the socket.

6. Apparatus according to claim 1, 2 or 3, in which the closure means is a spring-loaded valve.

7. Apparatus according to claim 4 in which the closure means is a spring-loaded valve.

8. Apparatus according to claim 5 in which the closure means is a spring-loaded valve.

9. A coupling for connecting a gas refill container to the reservoir of a gas burning cigarette lighter, the coupling comprising a screw-threaded neck and a complementary socket adapted to receive the neck, a closure member within the neck and a further closure member within the socket, the closure members being urged by a resilient part to a closed position but being engaged by means in the socket and neck respectfully and opened against the action of the resilient part when the neck and socket are screwed together, the venting passage being associated with closure means which close the venting passage when the neck and socket are screwed fully together but which open the venting passage to allow gas to escape from the reservoir as the neck and socket are unscrewed from each other.

10. A gas container for refilling the reservoir of a gas-burning cigarette lighter of the type provided with a filling socket, a closure

member in said socket, said member being urged by a first resilient part to a closed position, a closure opening member in said socket, said container comprising a wall defining a hollow screw-threaded neck mating with said socket, a closure member in said neck, said member being urged by a second resilient part to a closed position, a closure opening member in said neck adapted to co-operate with the closure opening member in said socket to open closure member in said socket against the action of said first resilient part when said neck is screwed part way thereinto, and then open the closure member in said neck against the action of said second resilient part when said neck is screwed further into said socket, said neck having in its wall a venting passage which is so positioned that it is closed when said neck is screwed so far into said socket that the closure means in said neck is opened by said closure opening means, but remains open when said neck is screwed into said socket only far enough to open the closure means in said socket, thus permitting gas to escape from said reservoir through said venting passage.

11. A gas reservoir for a gas-burning cigarette lighter which is adapted to be filled from a gas container of the type provided with a hollow screw-threaded neck, a closure member in said neck, said member being urged by a first resilient part to a closed position, a closure opening member in said neck, said reservoir comprising a wall defining a screw-threaded socket mating with said neck, a closure member in said socket, said member being urged by a second resilient part to a closed position, a closure opening member in said socket adapted to co-operate with the closure opening means in said neck to open the closure means in said socket against the action of said first resilient part when said neck is screwed part way into said socket and then open the closure member in said neck against the action of said second resilient part when said neck is screwed further into said socket, said socket having in its wall a venting passage which is so positioned that it is closed when said neck is screwed into said socket so far that the closure means in said

neck is opened by said closure opening means, but remains open when said neck is screwed into said socket only far enough to open the closure means in said socket, thus permitting gas to escape from said reservoir through said venting passage.

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CLAIMS SUPPORTED BY THE SUPPLEMENTARY DISCLOSURE

12. The combination of a gas-burning cigarette lighter having a gas reservoir and a gas refill container for refuelling the reservoir, wherein the reservoir has a screw-threaded gas inlet socket containing a spring-loaded inlet valve and the refill has a neck which is adapted to be screwed into the socket and which has a spring-loaded outlet valve, both the valves being opened against their springs as the neck is screwed into the socket and being closed again as the neck is unscrewed, the valve in the socket opening before and closing after that in the neck and the screw thread on the neck having a clearance within the screw thread in the socket to provide a helical venting passage between the threads, the passage being closed in that part of the relative movement between the socket and the neck in which the valve in the neck is held open, but being open in that part of the relative movement in which the valve in the neck is closed and the valve in the socket is open and thus establishing a connection between the reservoir and the atmosphere to allow gas to escape from the reservoir before and after filling.

13. The combination according to claim 12, in which a resilient sealing washer is provided in the socket to close the venting passage during the period in which both valves are open, the sealing washer being engaged by the end of the neck as the neck is screwed into the socket after the valve in the socket has opened but before the valve in the neck is opened.

14. The combination according to claim 12, in which the venting passage is closed during the time that both valves are open by some turns on the socket and on the neck which are a close fit with one another, these turns coming into

engagement with each other as the neck is screwed sufficiently far into the socket to start the opening of the valve in the neck.

15. The combination according to any one of claims 12 to 14, in which the thread on the neck is of V-shaped section and the thread in the socket is of similar section but with the crest of the thread flattened or rounded.

16. The combination according to any one of claims 12 to 14, in which the thread in the socket is of V-shaped section and the thread on the neck is of similar section but with the crest of the thread flattened or rounded.

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Fig. 2

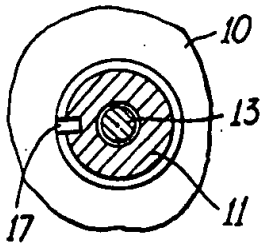


Fig. 1

Fig. 3

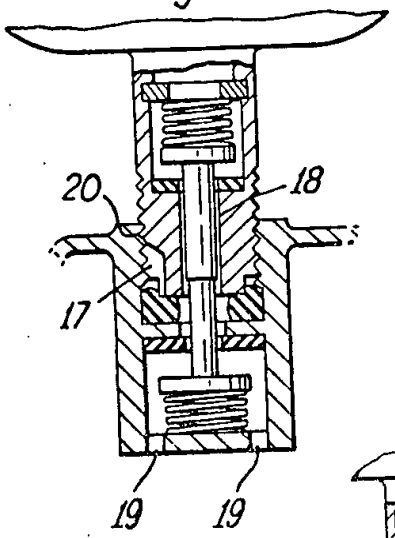


Fig. 4

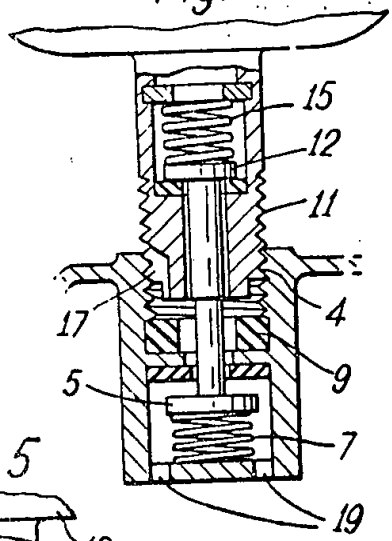


Fig. 5

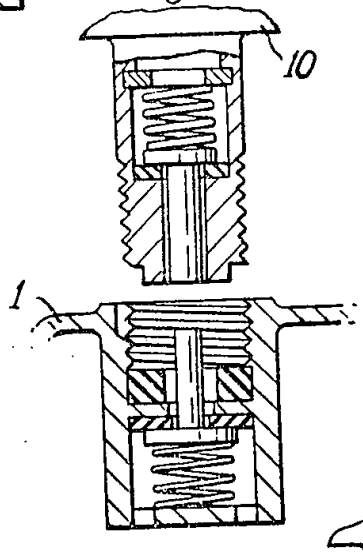


Fig. 6

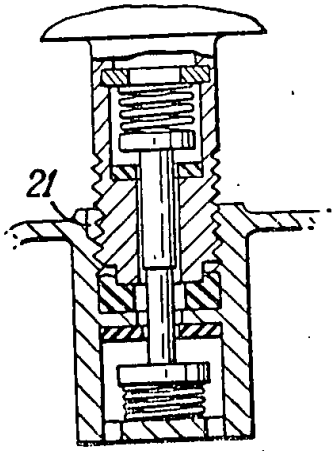


Fig. 7

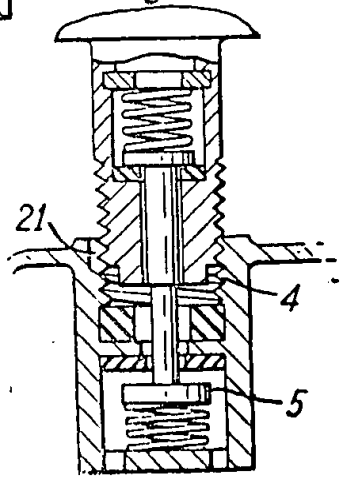


Fig. 8

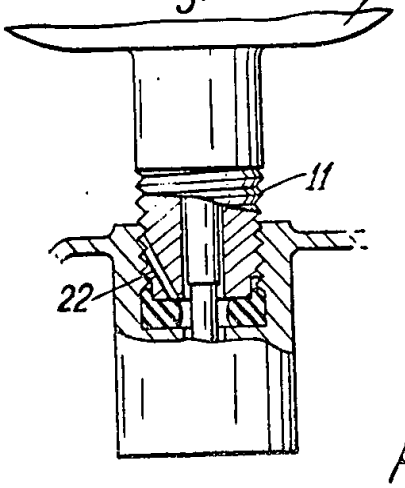


Fig. 9

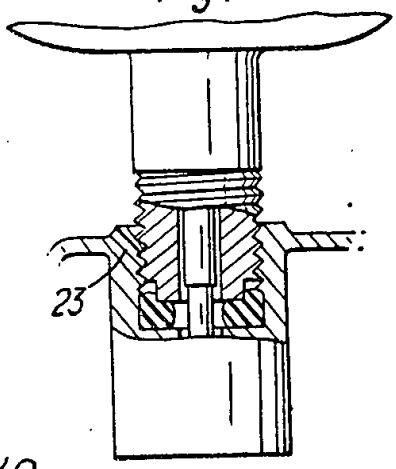


Fig. 10

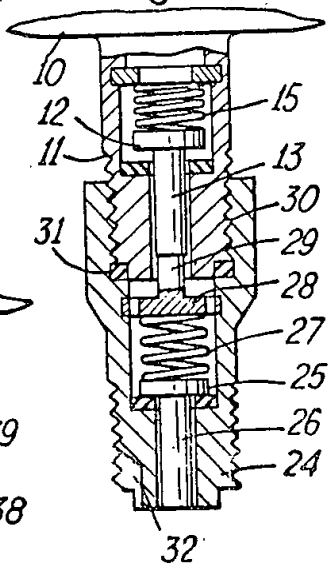


Fig. 11

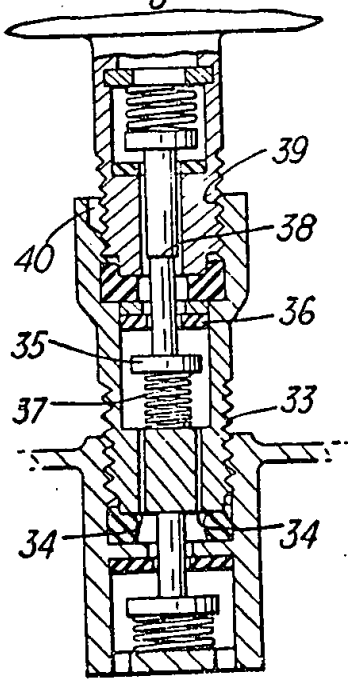


Fig. 12

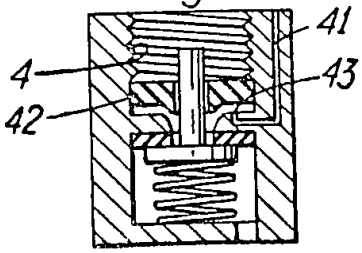
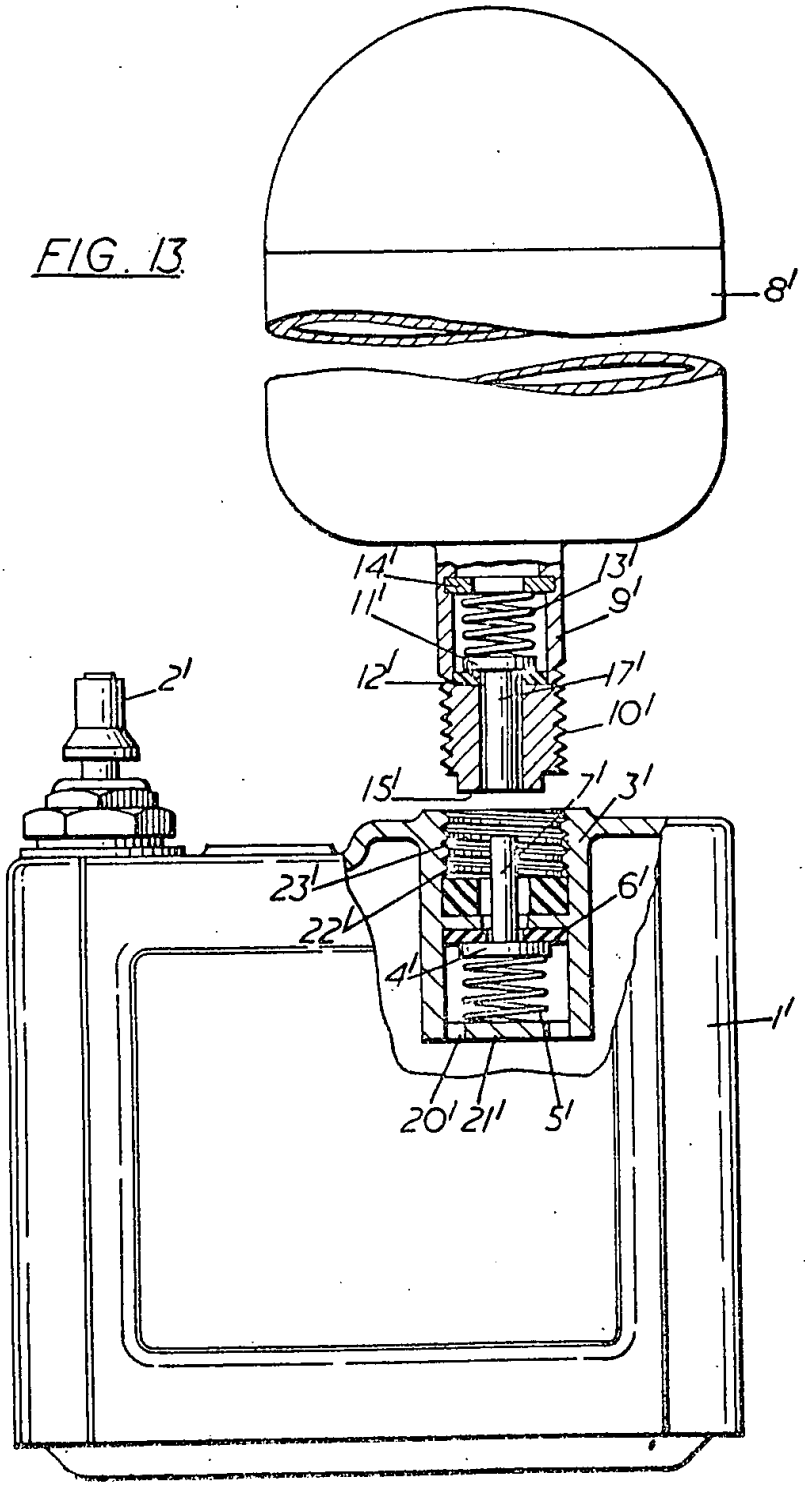


FIG. 13



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SUPPLEMENTARY DISCLOSURE

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FIG.14

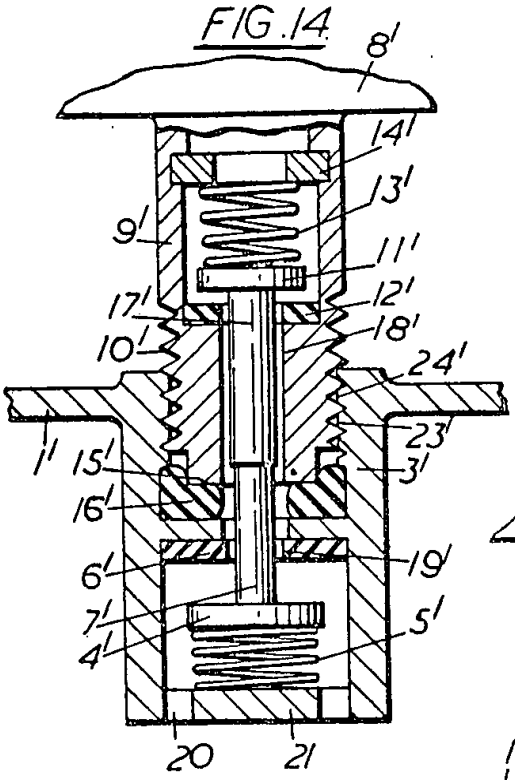

FIG.15

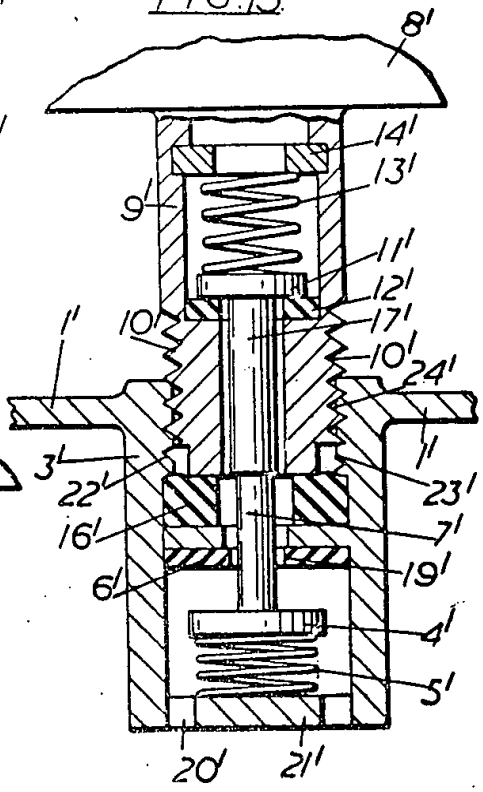

FIG.16